DE 197 58 498 C2 (1, WO 99/24292)
EP 1 037 778 B1

Description

Restraint system equipped with shoulder- and neck holder to increase survival chance

The present invention relates generally to a shoulder- and neck holder to increase survival chance for transport systems (motor vehicles, racing cars, racing-, high-speed boats, trains and aeroplanes), particularly, to additionally restrain the upper part of body a belted passenger in arbitrary collision of a motor vehicle, racing car, train, boat or an aeroplane against a barrier or in turbulence-related vibration of an aeroplane.

In order to formulate in single terminology a generalized definition for the proper term is presented:

"*belt portions 1.1, 1.2, 1.3 and 1.4*" for members of a multi-point seat belt **1a to 1d** (**Figs.** 1, 14) ref. to WO 99/24294 (DE 197 49 780 C2). The upper part of body is restrained by extending the shoulder belt portions **1.1, 1.2** crosswise in an "X-shape" while the lower part of body is restrained by the lap belt portion **1.3**.

"*belt portions 1.2, 1.3 and 1.4*" for members of a three-point belt **1e** to restrain the upper part of body in a "Λ-shape" and to restrain the lower part of body, shown in **Fig.** 14;

"*belt portion 1.3* " for conventional two-point or lap seat belt;

"*floor 6*" for vehicle-, train-, boat or aeroplane floor (**Fig.** 14);

"*accident*" of a motor vehicle, train, boat or aeroplane for front-, side-, rear collision of a motor vehicle or pile up (mass accident) or for boat, train-, aeroplane accident or turbulence-related vibration of an aeroplane;

"*energy-absorption*" for absorption and release of impact energy as well as damping the vibration;

"*undamped energy-absorption*" for absorption and release of impact energy while the vibration is undamped;

"*energy-absorbing method*" for gradually absorbing subenergies "ΔF_i", the addition of which is equal to total energy "F_n" or belt force (**Fig.** 9) and the increment i of which increases from 1 to n, below the respective injury-related values by undamped energy-absorption, energy-absorption, preserving the clamping and friction forces of control-clamping elements associated with the fracture of the sites of predetermined fracture of clamping elements and energy absorbers during the energy-absorption, thus enhancing the survival chance and ensuring the restraint below the tensile strength of seat belt.

It is well known to restrain passengers, particularly, of motor vehicles with seat belts in the event of an accident, where a small forward motion of the upper part of body at low speed is acceptable. However, in the crash tests at speed of 55 km/h the rotating masses of torso **95.2** and head **95.1** are thrown forward and twisted by the acceleration-dependant loads (**Figs.** 1 and 2).

Due to lack of restraint systems in trains passengers are not restrained, thus subjected to severe or fatal injury when ejected from the seats in accidents.

It is well known to restrain passengers of aeroplanes by two-point or lap seat belts, which are incapable of restraining the upper part of body as well as head in accidents, particularly associated with sudden turbulence. Consequently, severe/fatal injuries have been reported and, for sure, will be reported in the future.

According to US 2,833,554, US 3,392,989, US 3,713,694, US 3,901,550 (DE-A- 24 28 285), DE-A- 2151146 and EP-A- 0003354 (DE-A- 2803574) the restraint device, serving as *substitute for seat belt (restraint system)*, restrains both shoulders and/or the lap. This feature is in contradiction to the law, valid world-wide, enforcing the use of seat belts during travel. Unbelted passengers are not tolerated by the police and subjected to fine and court-verdict. Furthermore, Administration would reject vehicles, equipped with these restraint devices, thus putting the car manufacturer out of business.

According to US 3,901,550 (DE-A- 24 28 285), that has the best feature among the above-mentioned restraint devices, the passenger is secured by the restraint of both shoulders and the pelvis 96 by means of two pairs of air-cushioned guard arms. The following problem cases cast doubt on the survival chance and applicability:

I. Due to a gap between the shoulders and shoulder cap the shoulders and head **95.1** can oscillate. High injury severity results from
   1. large acceleration of head about 83 g, measured on a belted dummy in the crash test of a vehicle without airbag,
   2. limited energy-absorption property of the air chambers to dissipate large energy resulting from large acceleration of pelvis about 64 g, measured on the upper part of body of belted dummy, thrown forward, by a force and
   3. lack of neck cap to dissipate large energy of the head, yaw-accelerated at the yaw angle "O", acting as the second rotating mass.

   A passenger, submarining (slipping downward) in a rear collision, releases himself from the restraint by the guard arms, thus exposed to severe/fatal injury

   In an accident, the load cases of which are illustrated in **Figs.** 1 and 2, the survival chance is low due to lack of energy- and shock absorber.

II. Upper part of body, defined by various outer contour e.g. upon putting a thick winter coat, can't be retained because only a single outer contour is configured by pulling together the air chambers of guard arms via a tension strap. The outer contour is determined by two body shapes (both shoulders and chest) and the passenger, whose circumference varies depending on the clothes worn.

III. The manufacturing costs for two pairs of guard arms and two feeding systems are higher than that of the shoulder- and neck cap including seat belt.

According to DE-C- 37 06 394 a backrest of a front vehicle seat is equipped with deformation elements, which are deformed beyond the yield limit for the purpose of undamped energy-absorption when

- a passenger, seated in the front, is thrown against the seat backrest in a rear collision or
- an unbelted passenger, seated in the back, is thrown against the seat backrest in a front collision.

The supporting members of the seat backrest frame serve as deformation elements, to which expanding and contracting elements are arranged, whose geometry and limit of elasticity vary along the length of the seat backrest.

Ref. to DE-A- 42 38 549 thin walls of a seat backrest frame are proposed for undamped energy-absorption in a rear collision.

According to DE 92 02 219 U1 a belt retractor, equipped with a clamping device, acts as delimiter of a restraint system in conjunction with deformation and energy-absorption. The belt retractor and clamping device are connected to each other by a plate with ribs. Due to clamping of the belt in excess of a threshold value the ribs are deformed, thus increasing the distance of the clamping device from the belt retractor. The energy, imposed on the belted passenger, is released by the fracture of predetermined sites of the ribs.

A seat ref. to EP-A- 04234348 is proposed for survival chance in a mid-front collision of car, train or aeroplane. A pair of energy absorbers is pivotally attached to a pair of front and rear seat legs, which are pivotally attached to the floor and a seat frame. Each energy absorber consists of a rod, pivotally attached to the rear seat leg and floor and having a cone-shaped end, and a tube, pivotally attached to the front seat leg and seat frame and having a cone-shaped collar to receive the end of the rod. During the movement of the seat in a mid-front collision, the end of the rod expands (reams) the tube, thus performing work of deformation and friction in order to dissipate energy. For the purpose of gliding the end of the rod along the inner cylinder of the tube, the wall may not be cracked, but only deformed.

Exemplified by DE-A- 39 33 721, another energy absorbing friction-device, mounted to a vehicle part, has a tube, which is deformed by the belt force. The end of a rod, protruding through the tube, is connected to the seat belt and several barrels of a role (bearing balls) are arranged around the other end, inserted in the inner cylinder of tube. The outer diameter of the rod and barrels of a role is a little larger than the inner diameter of tube. Under the load of belt force the barrels of a role expand the inner cylinder of tube.
A very low work of deformation and friction is achieved, nevertheless, this invention contains the first-promising feature which only in co-operation with the seat belt is able to effectively absorb energy.

Accordingly, the principle object of the present invention is to ensure the restraint of both shoulders as well as of the neck of a belted passenger, shown in **Fig. 1**. This principle and other objects of the present invention and the aforementioned problems are accomplished by a number of features (proposals) having the following advantages:

- In compliance with the law, valid world-wide, enforcing the use of seat belts by the use of the conventional or newest seat belt ref. to EP-B- 1 037 773, the restraint of shoulders and/or neck by the holder can be determined before the travel/flight or in accident/turbulence or in excess of a threshold speed e.g. over 80 km/h. The deflecting point or end of a conventional seat belt (**Fig. 14**) is located at the top edge of seat backrest. The compound of two restraint systems minimizes movements/motions/torsions and all acceleration-dependant loads (**Fig. 1**), imposed, in particular, on shoulders, neck and head.
- The upper part **95** of body consists of a torso **95.2** and head **95.1**. In the z-y and x-y plane (**Fig. 1**) the pitch- and yaw angle "U_S" and "O" of the 1st mass of torso about the rotating "S"-and z-axes converge toward zero owing to the restraint of shoulders of the belted torso, thus reducing the forward motion, pitch acceleration "$\ddot{U}_S$"-, "$\ddot{U}_H$"- and yaw acceleration "$\ddot{O}$"-dependent force "F_{Sy}", "F_{Hy}" and "T" in arbitrary front collision. Analogously, the forces "T", "F_{Sx}", "F_{Ix}" and/or "F_{Sz}" are reduced in arbitrary side collision and/or rollover. This feature contributes to new development to increase the reliability of airbags by prolonging the deployment time, decreasing the volume and/or gas speed.
- Beyond doubt, one-piece neck cap **10.4a, 10.4c**, rigidly connected to shoulder cap **10.2a, 10.2c**, sustains the neck e.g. of a cervical trauma suffering passenger at the best. If such shoulder- and neck holders **10a, 10c** were installed in a vehicle, passenger would reject the use them when it is hot or the passenger is wearing tie or jewellery around her neck. This controversy is resolved by the features of the claim 1, 2 or 3.
- By making the caps **10.2, 10.2a to 10.2f** and a number of the respective alternate energy absorbers **10.3, 10.3a** even a passenger with broad shoulders can use the holder by changing shoulder caps.

Moreover, the overall stylish impression of seats is spoilt by shoulder- and/or neck-shaped caps, when not in use, thus impairing the sales. Understandably, the design of caps of holder e.g. **10d, 10e (Figs.** 1, 8) for expensive luxury cars depends, principally, on the form of the seat **3d, 3e**. To protect the broad shouldered passenger the shoulder caps must be changed. The decision for shoulder- or seat -shaped caps depends on the purpose of holders installed in the vehicle (bus, ambulance, van, luxury car etc.), train and aeroplane. This controversy is resolved by the features of the claims 4 to 10.

- The problem case II is resolved by variable restraint of a single body member comprising the shoulders and neck. Preferably, one- or two-piece, shoulder-shaped energy absorbers **10.3, 10.3a** can be detached from one- or two-piece, deformable caps **10.2, 10.2a to 10.2f** and one- or two-piece, neck-shaped energy absorbers **10.5, 10.5a, 10.5c** from one- or two-piece, deformable caps **10.4, 10.4a to 10.4c, 10.4f** as well as fastened thereto via adhesive fastener such as zip-, snap-in-, Velcro fastener. The absorber as well as cap can be made of one- or two pieces.

For the purpose of cost saving associated with the demand for passengers, with different neck- and shoulder shapes, a large number of neck- and shoulder-shaped energy absorbers **10.3, 10.3a, 10.5, 10.5a, 10.5c** and a low number of caps are produced. **Fig.** 14 exemplifies the adaptation of the holder to the body proportion of a child, sitting on the seat **3a, 3b**, by using detachable energy absorbers.

- For the purpose of quick storage and removal, the holder **10a to 10c** is inserted into the seat backrest or -cushion of seat **3a to 3c (Fig.** 14), secured by inserting the pair of latch plates **10.1, 10.1b, 10.1f** therein and released by pressing the release button **87a to 87c.** Both latch plates of shoulder- and neck holder **10a** are disengaged from seat cushion **3.1a (Fig.** 14) by pressing the release button **87a**. As front portion of that seat cushion the holder **10a** is removed from the cutaway portion (opening) to exploit its space for accommodation of both lower legs of a child sitting on the rear portion thereof.
- For the convenience of the passenger and in cases of quick-rescue and emergency a master release button **84** of buckle assembly **9.1** is pressed to release all latch plates of the seat belt from the respective buckle assemblies and
  * to move the holder **10d, 10e** back to the resting position or
  * to release all latch plates of holder **10, 10a to 10c, 10f** from the respective buckle assemblies.
- Both casings **29a** of rotatable device **28a** are guided by two pairs of auxiliary tubes **71, 72** of seat backrest frame **3.4d, 3.4e** and can be adjusted to the required height and locked.
- Large impact energy is absorbed, during which vibration is damped, by
  * fracture of pads of predetermined fracture "S_{11}" to "S_{mn}" and/or "H_{11}" to "H_{nm}" energy absorber **10.3, 10.3a** and/or **10.5, 10.5a, 10.5c**;
  * fracture of sites of predetermined fracture "s" of spring **10.9**;
  * fracture of sites of predetermined fracture of clamping elements of the following sets of energy absorbers **30, 40, 50 (Figs. 10 to 12)** having wires **37, 47, 57**, representing **40e, 40f** having wires **47e, 47f**, which are tautly, less tautly or loosely connected to holder **10e**; and
  * friction of clamping elements **32.1 to 32.e, 42.1 to 42.e, 52.1 to 52.e**, which move along the respective retaining elements **31, 41, 51**.
- The shoulder- and/or neck cap can be inserted or rotatably attached to or in the seat backrest. Furthermore, it can be adapted to the body proportion of a passenger by a width- and height-adjustable mechanism of the holder.

- The sets of energy absorbers and accommodation thereof in the seat backrest frame or seat frame account for a method of construction to save space, weight and costs and to increase stiffness. Furthermore, the energy-absorbing elements are made by extrusion, depth extrusion, casting, die casting or of spring plate or of spring steel. A preference for the embodiments is given to elements, having round profile, which are the cheapest and easiest to manufacture.

  The costs and reject rate are lowered by a single tolerance (over- or undermeasure of a round profile), pre-tensioning the clamping elements on or in the retaining element and pre-assembling all sets of energy absorbers, which are pre-loaded, for the delivery and final assembly to the seat- and/or seat backrest frame. The position of clamping elements e.g. **42, 42.1, ..., 42.n** to each other can be adjusted by choosing the adjusting holes "L_1" to "L_e" and/or by clamping the brackets **37b1** on the wires.

  Owing to the property of the great energy-absorption by small mass, lighter materials such as magnesium-, aluminium-extrusion, die casting of GD-MgA12 or alloys or carbon/glass fibre-reinforced plastics, used for skis, are recommended for the caps of the holder, latch plates and parts of the set of energy absorbers.
- Fracture of sites of predetermined fracture "s" can be used as a court-evidence for a passenger having belted in the accident.
- Retaining elements (**Figs.** 1, 10, 11), integrated into the seat backrest frame and/or seat frame, enormously increase the stiffness of seat. The retaining elements can be integral parts of the seat backrest frame or seat frame.
- The buckle assemblies, receiving the latch plates, are sustained by the seat backrest frame or seat frame.
- Two- or three-point seat belt can be fit out with sets of energy absorbers. The guide pieces of buckle assemblies, in plug-in connection with the respective latch plates, have two functions to integrate energy absorbers into the two-, three- or multi-point seat belt and to guide the movement of the buckle assemblies, when loaded or unloaded.
- Due to the increased tension on the wire the clamping element performs the work of deformation and friction, which is released in excess of threshold value resulting in fracture of sites of predetermined fracture "s", two sites shown in **Fig.** 11a, upon the contact with both heads of stop pin or bolt **46.1, ..., 46.n**. The site of predetermined fracture can be formed as crack, corrugation, hole or recess.
- In another embodiment the performed work (energy) is released by fracture
  * in excess of the yield limit of the clamping element,
  * due to constrained deformation of carrier piece or expanding (reaming) the clamping element upon the contact with a wedge-shaped stop element **41.3 (Fig.** 11) or with a wedge-shaped rib **41.1, 51.1 (Fig.** 12).

- Generally, the energy absorber consists of a tube-shaped base body with/without rib, serving as retaining element, and a clamping element, which is arranged to or in the retaining element. Wires are employed to tautly, less tautly or loosely connect
  * clamping elements to each other, whereby a row of energy absorbers e.g. **R42** (not denoted) is defined from the expanding clamping elements **42, 42.1 to 42.n** and the retaining element **41** (**Fig.** 11). In similar manner the other rows of energy absorbers such as **R32, R52** etc. can be built together;
  * rows of energy absorbers to define a set of energy absorbers **30, 40, 50** (**Figs.** 10 to 12) and
  * sets of energy absorbers to couple member **1.2a, 1.2b** of tie band (catch band) **1.1a, 1.1b, 1.5. 1.6, 47e, 47f** (**Figs.** 1, 13a to 13c) to dissipate subenergies "ΔF_i" by applying the energy-absorbing method.

Injury-irrelevant threshold value is defined by the difference between two forces "ΔF_i", lower than the injury-related load. The threshold values may have different magnitudes. For the energy-absorption up to the starting threshold value "ΔF_1", at least one clamping element **42e, 42f** (**Fig.** 1) or energy absorber **10.3, 10.3a, 10.5, 10.5a, 10.5c** is responsible. In order to prevent vibration and to fix the onset of energy-absorption at least one control-clamping element **52** must be pre-tensioned up to an onset force-level e.g. "ΔF_1 - 500 N", which is lower than "ΔF_1". Over this onset force-level the element, pulled by the corresponding wire **57**, performs work of deformation and friction, during which the energy "ΔF_1" is released by fracture of sites of predetermined fracture of clamping element **42e, 42f**, so that the passenger is neither injured nor thrown back. The energy increase about "ΔF_2" is compensated by the fracture of at least one next clamping element **52.1**, so that the passenger is neither injured nor thrown back.
The gradual reduction of energy is repeated so long up to a load zone defined of "ΔF_e - 500 N", in which all clamping elements are broken, the control-clamping elements **52** cannot move anymore and at least one control-clamping element **42**, pre-tensioned at "ΔF_f - 500 N", and/or at least one clamping element of set of energy absorbers **40** perform(s) work of deformation and friction.
The energy increase about "ΔF_f" is compensated by the fracture of the control-clamping elements **52** and/or of at least one next clamping element **42.1**, so that the passenger is neither injured nor thrown back. The gradual reduction of energy is repeated so long till

1. the total energy "F_n" is consumed or
2. a new load zone defined of e.g. "ΔF_h - 500 N", in which all clamping elements are broken, the control-clamping elements **42** can't move anymore and at least one of the following sets of energy absorbers decrease energy, such as.
   * **30, 40a, 50a** (not shown) of the other structural half of seat frame **3.3a**,
   * **40, 50** of the other structural half of seat backrest frame **3.4a**,
   * **30M, 40M, 50M, 65M** (not shown) fastened to the cross members **3.41, 3.42** of seat backrest frame **3.4a** facing each other,
   * **30N, 40N, 50N, 65N** (not shown) fastened to the cross members **3.31, 3.33** (not shown) of seat frame **3.3a** facing each other,

Because the passenger was subjected to a succession of injury-irrelevant threshold values "ΔF_i", where i = 1 to n, during the accident and restrained by the seat belt, tensile strength of which about 24000 N is substantially higher than "ΔF_i", he needs only to press the master release button **84**, detaching all latch plates from buckle assemblies, and egresses, uninjured, from the vehicle, train or aeroplane (**Figs.** 1 and 14).

- In another embodiment a sound-proofing material **83**, having arbitrary friction coefficient μ_0, different or progressive friction coefficient, is attached to the contact surface of retaining element and/or clamping element for the purpose of damping vibration and performing work of friction. Furthermore, it is possible to coat the retaining elements and corresponding clamping elements with material, having different friction coefficient, thus eliminating any noise.
- In the event of submarining and/or rollover the energy is dissipated by sets of energy absorbers, which are arranged in the seat frame and are tautly, less tautly or loosely connected to the buckle assembly.
- A single seat can be equipped with holder for persons (adults and/or children) of different ages related to weight groups, which depend on the appropriate sets of energy absorbers. The sets of energy absorbers and/or energy absorbers have different threshold values. With these features the survival chance is enhanced for children and the seat occupancy is optimized in train, bus or aeroplane.

A number of embodiments, other advantages and features of the present invention will be described in the accompanying tables and drawings with reference to the xyz global coordinate system:

Fig. 1 is a side view a rotatable shoulder holder **10e**, equipped with an energy absorbers **10.3**, rotated by the 2nd embodiment of a rotatable device **28a** from the resting position P to the operating position P_1.

Fig. 2 is a perspective view of a restrained dummy, thrown forward in an offset crash test.

Fig. 3 is a perspective view of the 1st embodiment of a half of a shoulder- and neck holder **10** equipped with a set of energy absorbers **10.3, 10.5** and latch plate **10.1**.

Fig. 4 is a schematic, perspective view of the 2nd embodiment of a shoulder- and neck holder **10a** equipped with a wider chin-supporting neck collar **10.4a**, energy absorbers **10.3a, 10.5a** and latch plates **10.1f**.

Fig. 5 is a schematic view of the 3rd embodiment of a half of a shoulder- and neck holder **10b** equipped with the energy absorbers **10.3, 10.5, 10.9**.

Fig. 6 is a schematic view of the 4th embodiment of a shoulder- and neck holder **10c** equipped with energy absorbers.

Fig. 7 is a schematic view of the 5th embodiment of a half of a shoulder- and neck holder **10f**, equipped with a latch plate **10.1f** in plug-in connection with a buckle assembly **4b**.

Fig. 8 is a perspective view of the 6th embodiment of a half of a rotatable shoulder holder **10d**, rotated by the 1st embodiment of a rotatable device **28** from the resting position P to the operating position P_1.

Fig. 9 illustrates a total load "F_n", absorbed by the restraint system associated with the energy-absorbing method, in the event of real accident.

Fig. 10 is a schematic, perspective view of the 1st embodiment of a set of energy absorbers **30, 40e, 40f**.

Fig. 11 is a schematic, perspective view of the 2nd embodiment of a set of energy absorbers **40, 40e, 40f**.

Fig. 11a is a partially enlarged perspective view of a clamping element with sites of predetermined fracture "s" and both heads of a stop pin to block the clamping element.

Fig. 12 is a schematic, perspective view of the 3rd embodiment of a set of energy absorbers **50, 40e, 40f**.

Fig. 13a is a schematic, perspective view of the 1st embodiment of a buckle assembly **4a** comprising a guide piece **4.7a**, release cable **4.2**, tie band **1.1a** and coupling member **1.2a**.

Fig. 13b is a schematic, perspective view of the 2nd embodiment of a buckle assembly **4b** comprising a guide piece **4.7b**, electrical motor **4.2b**, tie band **1.1b** and coupling member **1.2b**.

Fig. 13c is a cross-sectional view of the 3rd embodiment of a buckle assembly **4c** comprising two tie bands **1.5, 1.6** along the line II-II of **Fig.** 13d.

Fig. 13d is a cross-sectional view of buckle assembly **4.8c,** adjustable along the width of the back rest, having two holes to loosely guide two tie bands **1.5, 1.6.**

Fig. 14 is a front view of the safety seats **85a to 85e, 86**, resulting from the integration of the seat belts **1a to 1e** and shoulder holders **10, 10a, 10b, 10d, 10e** into seats **3a to 3e**, for passengers with different weights and body proportions.

In the 1st to 7th embodiment the shoulder- and neck holder **10, 10a to 10f**, shown in **Figs.** 1, 3 to 8, comprises

- one- or two-piece caps **10.2, 10.2a to 10.2f** with the shoulder-shaped energy absorbers **10.3, 10.3a** and/or
- one- or two-piece caps **10.4, 10.4a to 10.4c, 10.4f** with the neck-shaped energy absorber **10.5, 10.5a, 10.5c.**

The cap of shoulder- and neck holder **10, 10b (Figs.** 3 and 5) is built by inserting the pair of caps **10.4, 10.4b** into the pair of caps **10.2, 10.2b**. To restrain the shoulders and neck of a passenger, the one-piece holder **10a**, in closed form and using a connecting cap **10.11**, has the greatest stiffness, however by removing that connecting cap the holder **10c** in open form does not block out air flow. This controversy is resolved by the stiff rotatable device **28, 28a** of rotatable holder **10d, 10e** in the different embodiments.

The latch plate **10.1** is pivotally attached to the flange **10.12** of shoulder- and neck holder **10** by pin **10.6** or by bolt **10.6a** and nut **10.6b**. The adjustment to the shoulder shape is done by rotating the bolt **10.7** in threaded hole of flange **10.12**. Finally, that bolt is secured by nut **10.8**. Time is greatly consumed for the removal of the belt from the closed apertures of cap **10.2** and the latch plate **10.1**, to loosely guide the belt portion **1.1**, in order to store the holder. Thanks to the open aperture **10.14** of cap **10.2b, 10.2c, 10.2f** and open aperture of latch plate **10.1b**, the belt, when strapped over the holder, can be loosely locked, guided by quick-release pin **10.10** and released by withdrawal of quick-release pin.

In the 5th embodiment ref. to **Fig.** 7 the latch plate **10.1f** is secured to the flange **10.12f** by pin **10.6**, bolt **10.6a** and nut **10.6b**. By rotation of bolt **10.6a** in the threaded hole of flange **10.12f**, the cap **10.2f** can be moved along the width of the seat backrest to adapt to the width of the neck and/or shoulders of a passenger.

In the 1st or 2nd embodiment ref. to **Figs.** 1 and 8 each of the pair of casings **29, 29a**, form-locking connected to each other, of rotatable device **28, 28a** of holder **10d, 10e** consists of two tubes

- **28.1, 28.2**, force-locking connected with the coupling wall **28.3**, and an L-shaped plate **28.4**, or
- **41e, 41f**, force-locking connected with the coupling wall **28.3**, and an L-shaped, partly laterally closed and partly laterally open plate **28.4a**.

The end of each rotatable lever **28.5, 28.5a** is loosely guided between plate **28.4, 28.4a** and coupling wall **28.3**. Both rotatable levers are connected to each other by shaft **28.7**. The cap **10.2d, 10.2e** and release cam **28.6, 28.6a** are fastened to the other end of each rotatable lever. In resting position each cap is located in the seat backrest or its upper portion, if necessary, underneath the head rest **3.6a**. If a supporting tube **3.61** is available, the cap, recessed about that supporting tube, must be reinforced by reinforcing plate **10.13**.
Because the tubes **28.1, 28.2** or **41e, 41f** are guided by auxiliary tubes **71, 72** of seat backrest frame **3.4d, 3.4e**, the height of the casings is adjusted in the direction of arrow "U" (**Figs.** 1, 8) by manual operation or by a drive apparatus **80** e.g. hydraulic-piston cylinder unit, electrical motor (not drawn), similar to **4.2b** shown in **Fig.** 13b. Upon depressing the master release button **84** of buckle assembly **9.1 (Fig.** 14) the electrical motor is activated to move the holder **10d, 10e** back to the resting position.
The long tubes **41e, 41f**, serving as retaining elements and girders, are parts of seat backrest frame **3.4d, 3.4e** and energy absorbers **40e, 40f** having clamping elements **42e, 42f**, which are tightly, less tightly or loosely connected to the pair of rotatable levers **28.5a** via the stop pieces **28.9a**, serving as deflectors, by wires **47e, 47f** in order to determine the onset of energy-absorption. Due to the forward motion of the dotted-line torso **95.2** and head **95.1** each dotted-line rotatable lever **28.5a** with cap **10.2e** is rotated to the position P_2 through the opening of L-shaped, partly laterally-closed and partly laterally-open plate **28.4a**, during which the work of deformation and friction is achieved by the deflection of the dotted-line clamping elements **42e, 42f** along the respective retaining elements **41e, 41f**. The stored energy is released in excess of the yield strength and/or of the threshold values. Additional clamping elements can be arbitrarily arranged or be series-connected to clamping element **42e, 42f** to absorb great energy and damp vibration.
The belt portion **1.1, 1.2** is loosely guided by U-shaped plate **10.15**, similar to **10.14**, of cap **10.2e** and, if necessary, loosely locked by quick-release pin **10.10 (Fig.** 5).

Due to the rotation of both rotatable levers **28.5, 28.5a**, operated manually or by drive apparatus **80**, both release cams **28.6, 28.6a** force the rotation of the lock pawls **28.8, 28.8a**, pre-loaded by springs **28.10, 28.10a**, thereby permitting the locking pins **28.12**, pre-loaded by springs **28.13**, and loosely guided in tubes **28.11**, to move into the holes **28.14** and block the rotatable levers. When blocked, the loads in the event of rollover, yawing or turbulence-related vibration are reduced by the deformable holder **10d, 10e** equipped with energy absorbers **10.3**. The position of each tube **28.11** at the coupling wall **28.3** is denoted by the hole **28.14**. From the operating position P_1 to the resting position P both rotatable levers **28.5, 28.5a** snap into the stop pieces **28.9, 28.9a** and are retained thereby.

In the 1st embodiment the set of energy absorbers **30, 40e, 40f (Fig.** 10) comprises a retaining element **31**, control-clamping element **32** and clamping elements **32.1 to 32.n** (not drawn). After projecting through or into the cylinder-shaped edges **37c1** of control-clamping element **32**, both end portions of auxiliary wire **37a1** of wire **37** are secured by clamping two brackets **37b1** or both cylinder-shaped ends **37c1** therewith. The inner diameter "d_i" of clamping element **31, 41** is a little larger than the outer diameter "d_i" of auxiliary tubes **71, 72**.

In the 2nd embodiment ref. to **Fig.** 11, 11a the set of energy absorbers **40, 40e, 40f** comprises a retaining element **41**, control-clamping element **42** and clamping elements **42.1 to 42.n**. Owing to taut, less taut and/or loose connection of wires **47.1, ..., 47.n** with the clamping elements **42, 42.1, ..., 42.n**, if necessary by occupying another pair of adjusting holes "L_1 to L_e", the onset of each clamping element, pre-tensioned, is determinable. Owing to arbitrary connection of wires with arbitrary clamping elements the fracture of the clamping elements can be pre-determined in an arbitrary succession. Determinable, too, is the fracture of each clamping element to absorb energy, e.g. by reaming (bulging) the clamping element **42.1, ..., 42.n** in contact with both heads of stop pin or bolt **46.1, ..., 46.n** with both sides of wedge-shaped stop element **41.3** or by fracture in excess of the yield strength when increasingly loaded.

In the 3rd embodiment ref. to **Fig.** 12 the set of energy absorbers **50, 40e, 40f** comprises a cone-shaped retaining element **51**, control-clamping element **52** and clamping elements **52.1, .., 52.n** and **53.1, .., 53.n** (not-shown). Both ends of auxiliary wire **57a1** of wire **57** are secured to a control-clamping element **52** by rivets **57b1**.
The load-deflection area is achieved progressively or arbitrarily by the expansion of cone-shaped clamping element **52, .., 52.n, 53, ...,53.n** along

- the cone-shaped retaining element **51** and/or
- the longitudinal rib **51.1** whose thickness longitudinally increases.

In the 1st and 2nd embodiment of the buckle assembly **4a, 4b** (**Figs.** 13a and 13b), to receive latch plate **2, 11, 25**, the one-piece guide piece **4.7a, 4.7b** is provided with a recess **4.5a** or longitudinal groove **4.5b** to loosely guide tie band **1.1a, 1.1b**, having coupling member **1.2a, 1.2b**, to which the wires of sets of energy absorbers **30, 40, 50** are tautly, less tautly or loosely connected.
After the insertion, in the direction of double arrow, of a pair of engaging parts **4.10a, 4.10b** of guide piece **4.7a, 4.7b** in the apertures of the housing **4.8a, 4.8b** of buckle assembly **4a, 4b** the clamping parts **4.12** snap into the clamping holes **4.13**.
When the latch plate is pulled under the load of "ΔF_1 - 500 N", less than the starting threshold value "ΔF_1", the buckle assembly, clamping element/s and energy absorber/s move about the deflection "T_F" (not drawn). In the state of non-deformation the housing **4.8a, 4.8b** with/without clamping parts **4.12** must be pulled back into the engaging parts **4.10a, 4.10b**. This is possible, when "T_L" is at least as long as "$T_S + T_F$". Experiment can clarify, whether the clamping parts and clamping holes are needed. However, the clamping assemblies have the advantage of exactly positioning the buckle assembly in the seat backrest or -cushion.
Due to the restriction for the depth "T" of seat backrest or -cushion(**Fig.** 14) the length "T_L" of engaging parts **4.10a, 4.10b** is restricted too, hence, the following countermeasures are required:

- When the buckle assembly under load of great impact energy moves along the engaging parts, the tie band **1.1a, 1.1b** must be guided by the guide piece **4.7a, 4.7b**, fastened to seat backrest frame or seat frame, generally the frame of seat.
- In order to exploit the depth "T", the length "T_Z" of latch plate and/or the length "T_L" of engaging parts **4.10a, 4.10b** is/are increased;
- By not using guide piece the wires of sets of energy absorbers can tautly, less tautly or loosely be connected to couple member **1.2a, 1.2b** or an end of the seat belt; and/or
- Owing to pre-tensioning at least one control-clamping element **32, 42, 52** at "ΔF_1 - 500 N" the housing cannot move.

In the 3rd embodiment of the buckle assembly **4c** (**Fig.** 13c), to receive latch plate **2, 9, 11, 25**, the housing **4.8c**, that can be moved along a pair of tube **27.3** of the seat backrest or seat frame and latched thereon, are provided with two holes **4.5c** to loosely guide tie bands **1.5, 1.6**, having couple members **1.2a, 1.2b**. A wire is projected through the hole **2.3** of buckle assembly **4c**. Both end portions, serving as tie bands **1.5, 1.6**, are secured by bracket **1.7**. The engaging part **4.10c** of buckle assembly **4c** is in pig-tail- or form-locking connection to an aperture of housing **4.8c**. Large height- and width-adjustment can result in slackness and inaccuracy when pre-tensioning the wires. Such shortcoming is resolved by directly attaching the sets of energy absorbers to the parts (not drawn) of the height- and width-adjustable mechanism.

The buckle assembly **4a, 4b, 4c** is suited for buckle assembly **4, 7, 8, 8a, 9.1, 18a, 18b, 19a, 19b** (**Fig.** 14).

Another application results from direct conversion of a child-seat **85a** into a baby-cot **86** by flipping the seat backrest **3.2a** into a resting position. The passenger protection is optimized by insertable or rotatable attachment of the shoulder- and/or neck holder **10, 10a to 10f** to the seat backrest frame.

For children and persons, having very weak neck muscle, in particular when suffering from cervical trauma, the neck-shaped cap **10.4a** of holder **10a** is recommended. Its wider chin-supporting energy absorber **10.5a** (**Fig.** 4) improves the properties of bracing the head and substantially absorbing energy during the forward motion of the passenger.

Claims

1. A restraint system equipped with a shoulder holder to increase survival chance in an accident of a motor vehicle, train or an aeroplane or during turbulence-related vibrations of an aeroplane, wherein

a) the body of a passenger is restrained by a seat belt **(1a to 1e)** and the pair of shoulders by a shoulder holder **(10, 10a to 10f)**;
b) which is attached rotatably or insertably to or in a seat backrest **(3.2a to 3.2e)** and
c) over which the seat belt **(1a to 1e)** is extended.

2. A restraint system equipped with a shoulder- and neck holder according to claim 1, wherein the pair of shoulders and the neck are restrained by a shoulder- and neck holder **(10, 10a to 10f)**, defined by

a) a cap **(10.2a, 10.2c)** of the shoulder holder **(10, 10a to 10f)** and a cap **(10.4a, 10.4c)** of a neck holder or
b) a pair of caps **(10.2, 10.2b, 10.2d to 10.2f)** of the shoulder holder and a pair of caps **(10.4, 10.4b)** of a neck holder.

3. A restraint system according to claim 2, wherein the pair of neck caps **(10.4, 10.4b)** is insertably connected to the pair of shoulder caps **(10.2, 10.2b, 10.2d to 10.2f)** and detachable therefrom.

4. A restraint system according to at least one of the preceding claims, wherein the shoulder- and/or neck holder **(10, 10a to 10f)** is provided with at least one energy absorber **(10.3, 10.3a, 10.5, 10.5a, 10.5c, 10.9)**.

5. A restraint system according to claim 4, wherein the energy absorber **(10.3, 10.3a, 10.5, 10.5a, 10.5c)** is fastened to the shoulder- and/or neck cap **(10.2, 10.2a to 10.2f, 10.4, 10.4a to 10.4c, 10.4f)** by an adhesive fastener such as zip-, snap-in-, Velcro fastener and detachable therefrom by opening the fastener.

6. A restraint system according to at least one of the preceding claims, wherein the shoulder caps **(10.2, 10.2a to 10.2f)** are shoulder-shaped.

7. A restraint system according to at least one of claims 4 to 6, wherein the energy absorber **(10.3, 10.3a)** is shoulder-shaped.

8. A restraint system according to at least one of claims 2 and 5, wherein the neck cap **(10.4, 10.4a to 10.4c)** is neck-shaped.

9. A restraint system according to at least one of claims 4, 5 and 8, wherein the energy absorber **(10.5, 10.5a, 10.5c)** is neck-shaped.

10. A restraint system according to at least one of claims 8 and 9, wherein the energy absorber **(10.5a)**, arranged in the neck cap **(10.4a)**, serves as a neck collar having a wide portion for the chin.

11. A restraint system according to at least one of the preceding claims, wherein buckle assemblies, to which a pair of latch plates **(10.1, 10.1b, 10.1f)** of the shoulder- and neck holder **(10, 10a to 10c, 10f)** is connected, are attached to a seat backrest frame **(3.4a to 3.4c)**.

12. A restraint system according to at least one of the preceding claims, wherein all latch plates of the seat belt **(1a to 1c)** and the shoulder- and neck holder **(10, 10a to 10c, 10f)** are disengaged from the buckle assemblies upon the pressure on a master release button **(84)** of the buckle assembly **(9.1)**.

13. A restraint system according to claim 12, wherein the shoulder- and/or neck holder **(10, 10a, 10b)** is fastened to the seat backrest **(3.2c)** or seat cushion **(3.1a, 3.1b)** for the purpose of storage and detachable therefrom upon the pressure on a release button **(87a to 87c)**.

14. A restraint system according to at least one of claims 1 to 10, wherein the shoulder- and/or neck holder **(10d, 10e)** is provided with a manually operated or motor-driven rotatable device **(28, 28a)**, which is height-adjustable and/or rotatably attached to a seat backrest frame **(3.4d, 3.4e)**.

15. A restraint system according to claim 14, wherein the cap **(10.2d, 10.2e)**, recessed about the supporting tube **(3.61)** of the head rest **(3.6)**, is reinforced by a reinforcing plate **(10.13)**.

16. A restraint system according to at least one of claims 14 and 15, wherein a drive apparatus **(80)** rotates the shoulder- and/or neck holder **(10d, 10e)** about both shoulders of the passenger from the resting position (P) to the operating position (P_1).

17. A restraint system according to claim 16, wherein the drive apparatus **(80)** is activated by a separately operated switch, a governor controlling the limitation of speed, an accelerator pedal or a sensor.

18. A restraint system according to at least one of claims 1 to 11, 16 and 17, wherein when the master release button **(84)** of the buckle assembly **(9.1)** is pressed, all latch plates of the seat belt **(1d, 1e)** are disengaged from the buckle assemblies and the drive apparatus **(80)** moves the shoulder and/or neck holder **(10d, 10e)** back from the operating position (P_1) to the resting position (P).

19. A restraint system according to claim 2, wherein the cap of the shoulder- and neck holder **(10a, 10c)** is made of one piece.

20. A restraint system according to claim 19, wherein the cap of the shoulder- and neck holder **(10a)** is reinforced by a connecting cap **(10.11)**.

21. A restraint system according to at least one of claims 1 to 10, wherein a removable front portion of the seat cushion **(3.1a)** serves as a holder **(10a)** and the space thereof is exploited to accommodate the legs of a child sitting on the rear portion thereof.

22. A restraint system according to at least one of claims 1 to 11, wherein the belt portion **(1.1, 1.2)** is loosely guided by

- a closed aperture of the shoulder cap **(10.2)** and a closed aperture of the latch plate **(10.1)**; or
- a U-shaped plate **(10.15)** of the shoulder cap **(10.2d, 10.2e)**; or
- an open aperture **(10.14)** of the shoulder cap **(10.2b, 10.2c)** and an open aperture of the latch plate **(10.1b)**.

23. A restraint system according to claim 22, wherein the belt portion **(1.1, 1.2)**, extending over the aperture of the latch plate **(10.1b)** or the U-shaped plate **(10.15)**, is loosely secured by a quick-release pin **(10.10)** and releasable by withdrawal thereof.

24. A restraint system according to at least one of claims 1 to 6, wherein the shoulder cap **(10.2, 10.2f)** is height- and/or width-adjustable by rotating a bolt **(10.7, 10.6a)** in the threaded hole of a flange **(10.12, 10.12f)**.

25. A restraint system according to at least one of claims 1 to 11, 16 and 17, wherein when a master release button **(84o)**, arranged to the seat cushion **(3.1a to 3.1e)**, is pressed,
- the pair of latch plates **(10.1, 10.1b, 10.1f)** of the shoulder- and neck holder **(10, 10a to 10c)** are disengaged from the buckle assemblies **(18a / 19a to 18n / 19n)** or
- the drive apparatus **(80)** moves the shoulder holder **(10d, 10e)** back from the operating position **(P_1)** to the resting position **(P)**.

26. A restraint system according to at least one of the preceding claims, wherein
a) a buckle assembly **(4a to 4c, 8, 8a, 9.1)** is arranged to a seat frame **(3.3a to 3.3e)** to receive a latch plate **(9, 11, 25)**;
b) which is moveable along the belt portion **(1.3a to 1.3e)**;
c) where the buckle assembly **(4a to 4c, 8, 8a, 9.1)** is connected to at least one energy absorber **(30, 40, 40e, 40f, 50)** by means of at least one wire **(37, 47, 47e, 47f, 57)**.

27. A restraint system according to at least one of the preceding claims, wherein at least one buckle assembly **(4, 4a to 4c, 18a, 18b, 19a, 19b)** is
a) arranged to the seat backrest frame **(3.4a to 3.4e)** and
b) connected to at least one energy absorber **(30, 40, 40e, 40f, 50)** by means of at least one wire **(37, 47, 47e, 47f, 57)**.

28. A restraint system according to claim 26 or 27, wherein the energy absorber **(30, 40, 40e, 40f, 50)** comprises at least one clamping element **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** and a retaining element **(31, 41, 41e, 41f, 51)**, which
- is fastened to the seat backrest frame **(3.4a to 3.4e)** or seat frame **(3.3a to 3.3e)**; or
- is integral part thereof.

29. A restraint system according to claim 28, wherein the clamping element **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** has open and tube-shaped profile.

30. A restraint system according to claim 28, wherein the retaining element **(31, 41, 41e, 41f, 51)** is tube-shaped.

31. A restraint system according to claim 30, wherein a longitudinal rib **(41.1, 51.1)** is arranged to the retaining element **(41, 41e, 41f, 51)**.

32. A restraint system according to claims 29 and 31, wherein both edges of the clamping element **(42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** are loosely guided by the longitudinal rib **(41.1, 51.1)** in longitudinal direction.

33. A restraint system according to claim 31, wherein at least one stop element **(41.3)** is arranged to the longitudinal rib **(41.1, 51.1)**.

34. A restraint system according to at least one of claims 31 to 33, wherein the thickness of the longitudinal rib **(41.1, 51.1)** increases in longitudinal direction.

35. A restraint system according to at least one of claims 29 to 34, wherein the clamping element **(52, 52.1 to 52.n)** is cone-shaped.

36. A restraint system according to at least one of claims 30 to 35, wherein the retaining element **(51)** is cone-shaped.

37. A restraint system according to at least one of claims 29 to 36, wherein the clamping element **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)**, pre-tensioned and arranged along the retaining element **(31, 41, 41e, 41f, 51)**, is provided with sites of predetermined fracture (s), which have at least one threshold value.

38. A restraint system according to at least one of claims 29 to 36, wherein at least one stop pin **(46, 46.1 to 46.n)** is laterally arranged to the retaining element **(31, 41, 41e, 41f, 51)**, where the pin blocks the movement of the clamping element **(42, 42.1 to 42.n)**, thus resulting in fracture of the sites of predetermined fracture (s) when the threshold value is exceeded.

39. A restraint system according to at least one of claims 30 to 38, wherein the contact surfaces of the retaining element **(31, 41, 41e, 41f, 51)** have arbitrary friction coefficients (μ_0).

40. A restraint system according to at least one of claims 30 to 39, wherein the contact surfaces of the retaining element **(31, 41, 41e, 41f, 51)** are provided with a soundproofing material **(83)**.

41. A restraint system according to at least one of claims 29 to 40, wherein the contact surfaces of the clamping element **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** have arbitrary friction coefficients (μ_0).

42. A restraint system according to at least one of claims 29 to 41, wherein the contact surfaces of the clamping element **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** are provided with a soundproofing material **(83)**.

43. A restraint system according to at least one of claims 29 to 42, wherein the end portions of an auxiliary wires **(37a1)**, connected to a wire **(37)**, are inserted into both cylinder-shaped edges **(37c1)** of the clamping elements **(32)** and secured by clamping the edges **(37c1)** with the end portions or by clamping two brackets **(37b1)** to the termini thereof.

44. A restraint system according to at least one of claims 29 to 42, wherein the clamping element **(42, 42.1 to 42.n, 52, 52.1 to 52.n)** is provided with a pair of ribs, whereto several pairs of adjusting holes (L_1 to L_e) are arranged.

45. A restraint system according to at least one of claims 26 to 44, wherein a set of energy absorbers **(30, 40, 40e, 40f, 50)**, equipped with the wire **(37, 47, 47e, 47f, 57)**, comprises the retaining element **(31, 41, 41e, 41f, 51)**, at least one stop pin **(46, 46.1 to 46.n)**, at least one stop element **(41.3)** and several clamping elements **(32, 32.1 to 32.n, 42, 42.1 to 42.n, 42e, 42f, 52, 52.1 to 52.n)** with/without sites of predetermined fracture (s), where clamping elements, arranged along the retaining element **(31, 41, 41e, 41f, 51)**, are tautly, less tautly or loosely connected to each other by means of wires **(37, 37.1 to 37.n, 47, 47.1 to 47.n, 47e, 47f, 57, 57.1 to 57.n)**.

46. A restraint system according to claim 45, wherein an energy absorbing device comprises a couple member **(1.2a, 1.2b)** and one or several sets of energy absorbers **(30, 40, 40e, 40f, 50)**, the wires **(37, 47, 47e, 47f, 57)** of which are tautly, less tautly or loosely connected to the couple member **(1.2a, 1.2b)**.

47. A restraint system according to claim 46, wherein a guide piece **(4.7a, 4.7b)** is fastened to the seat frame **(3.3a to 3.3e)** or seat backrest frame **(3.4a to 3.4e)**, where the guide piece has
a) a pair of engaging parts **(4.10a, 4.10b)**, form-locking connected to the respective apertures of a housing **(4.8a to 4.8c)** of the buckle assembly **(4a, 4b)**; and
b) a recess **(4.5a)** or longitudinal groove **(4.5b)** to loosely guide a tie band **(1.1a, 1.1b)**, one end of which is connected to the buckle assembly **(4a, 4b)** and the other end to the couple member **(1.2a, 1.2b)**.

48. A restraint system according to claim 46, wherein a housing **(4.8c)**, movable along a pair of tubes **(27.3)** of the seat backrest frame **(3.4a to 3.4e)** or seat frame **(3.3a to 3.3e)** and latchable thereon, has
a) an aperture to receive an engaging part **(4.10c)** of the buckle assembly **(4c)**, through a hole **(2.3)** of which a wire is protruded and both end portions of the wire, serving as tie bands **(1.5, 1.6)**, are secured by a bracket **(1.7)**; and
b) two holes **(4.5c)** to loosely guide the tie bands **(1.5, 1.6)**, connected to the couple members **(1.2a, 1.2b)**.

49. A restraint system according to at least one of the preceding claims, characterized by use of metal, compound material, fibre reinforced material or non-metal material for material of the parts of the shoulder- holder, neck holder and set of energy absorbers.

Abstract

Failure of present restraint systems is substantiated by severe/fatal injuries in the event of real accident of a vehicle, train or turbulence-related vibration of an aeroplane, e.g. upon the loss of 300 m height within short time. The pitch-, yaw- and lateral acceleration-dependant loads are reduced and the oscillating movement are damped by

- shoulder holder **(10, 10e)** to substantially restrain both shoulders **(95.2)** and the neck **(95.1)** of a belted passenger;
- work of deformation and friction performed by sets of energy absorbers **(10.5, 40e, 40f, 30, 40, 50)**;
- gradually absorbing the subenergy "ΔF_i" and damping the vibration in excess of the injury-irrelevant threshold value till the total energy "F_n" is consumed.

The space in the seat- and seat backrest frame is exploited to accommodate the sets of energy absorbers and rotatable device **(28a)**.
For the convenience of the passenger and in cases of quick-rescue and emergency the master release button **(84)** of buckle assembly is pressed to

- release all latch plates from buckle assemblies and/or
- move the holder **(10e)** back to resting position.

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Int. Cl.^{7}: B 60 R 22/12
Veröffentlichungstag: 5. Juli 2001

Prior Art / Stand der Technik

Fig. 2

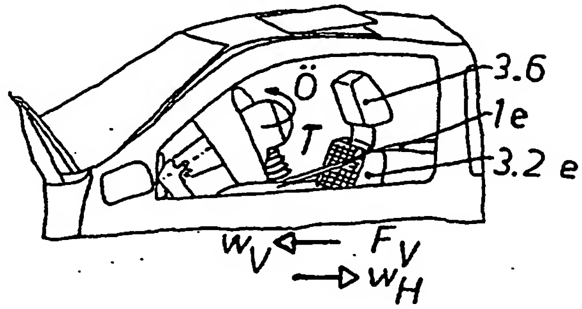
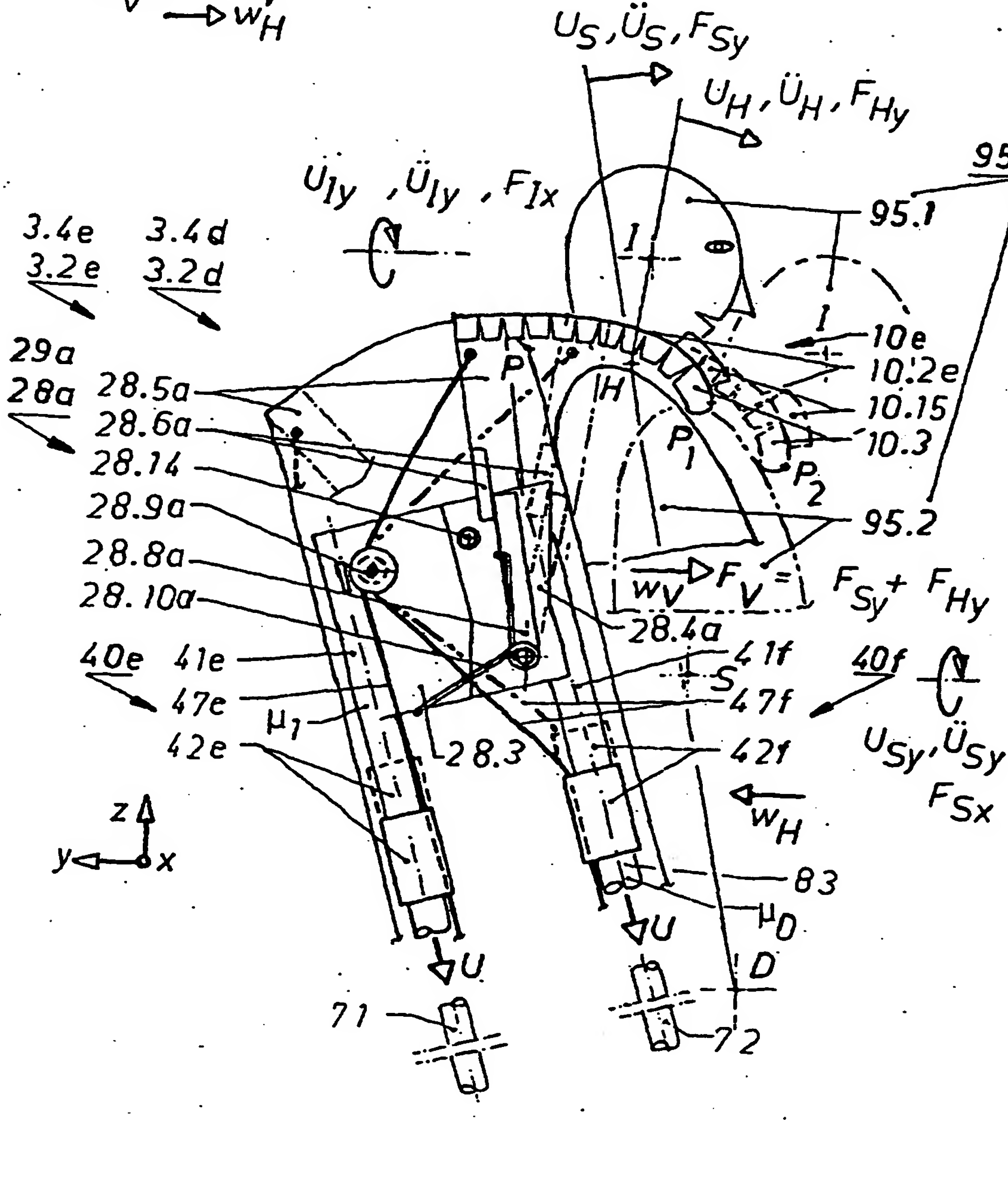


Fig. 1



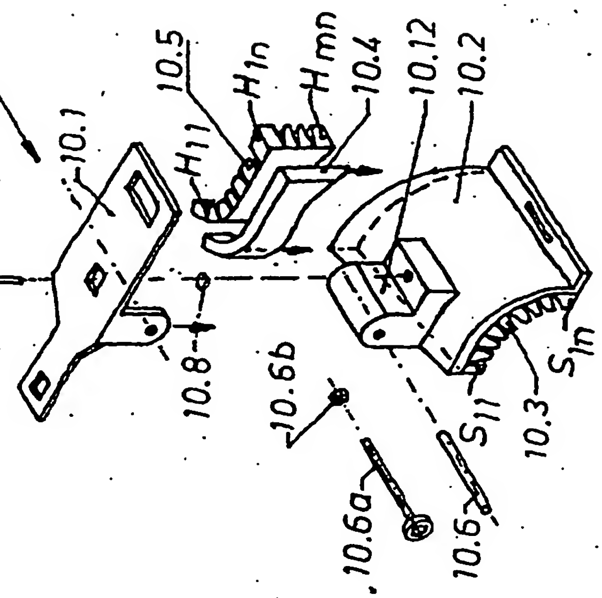


Fig. 3

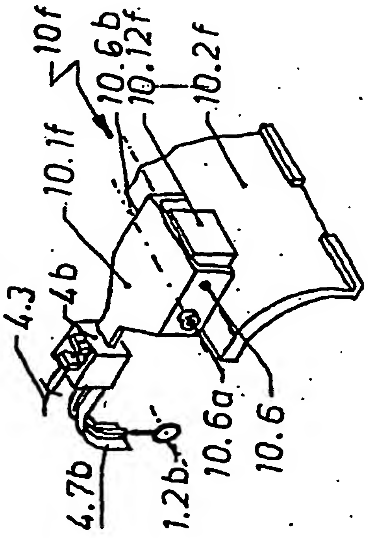


Fig. 7

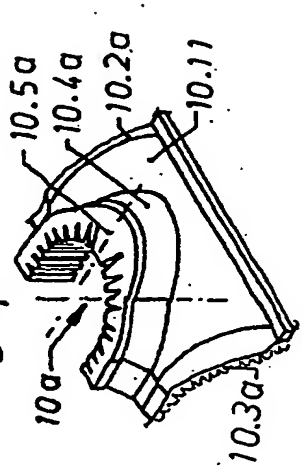


Fig. 4

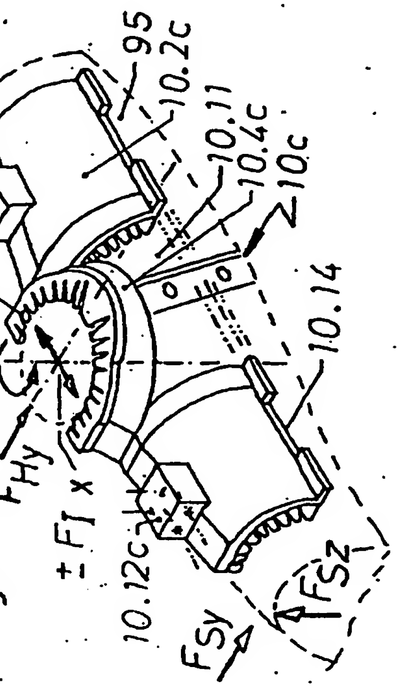


Fig. 6

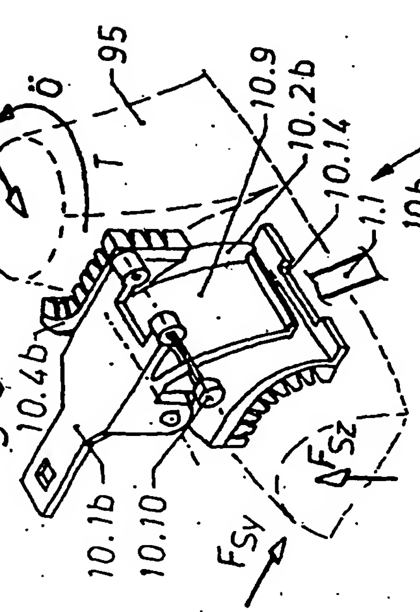


Fig. 5

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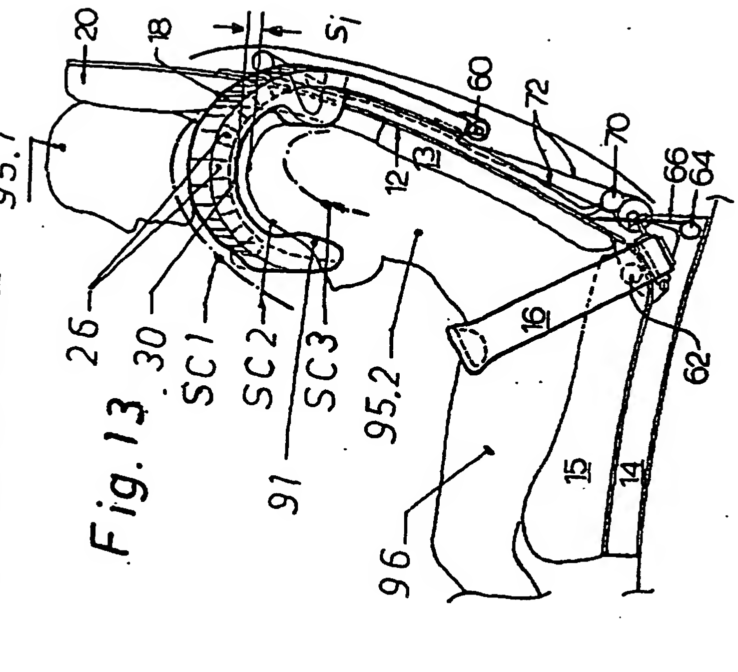

Fig. 13

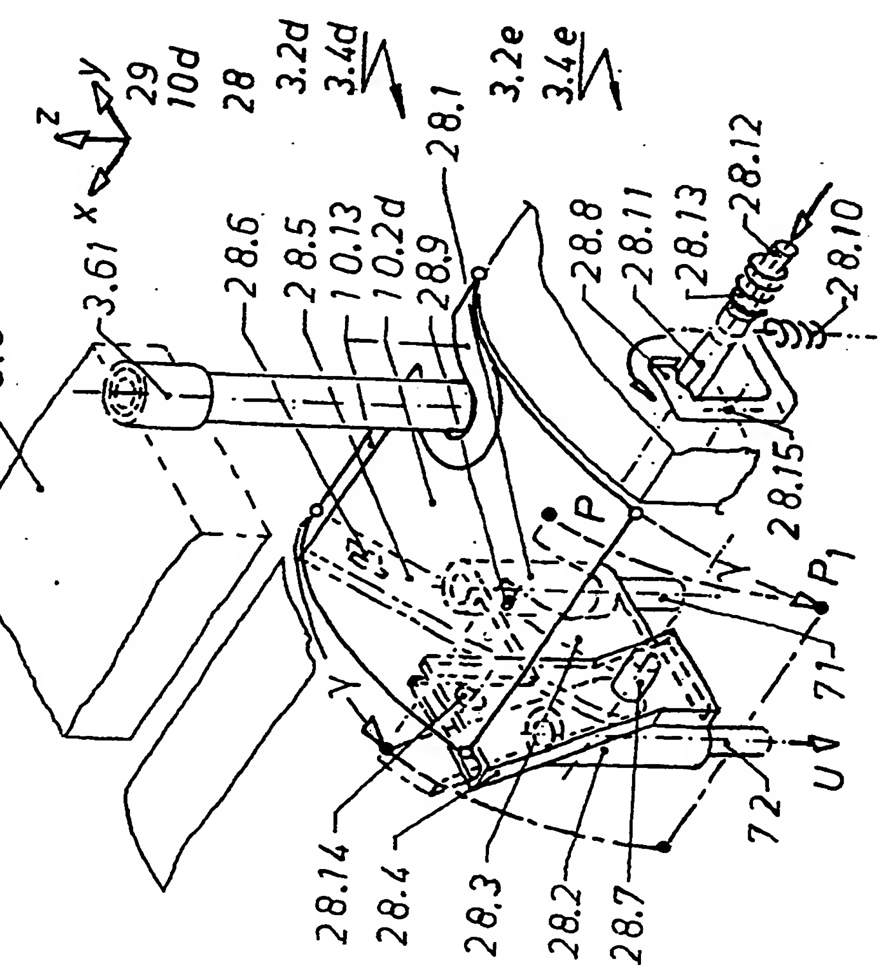

Fig. 8

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Fig. 9

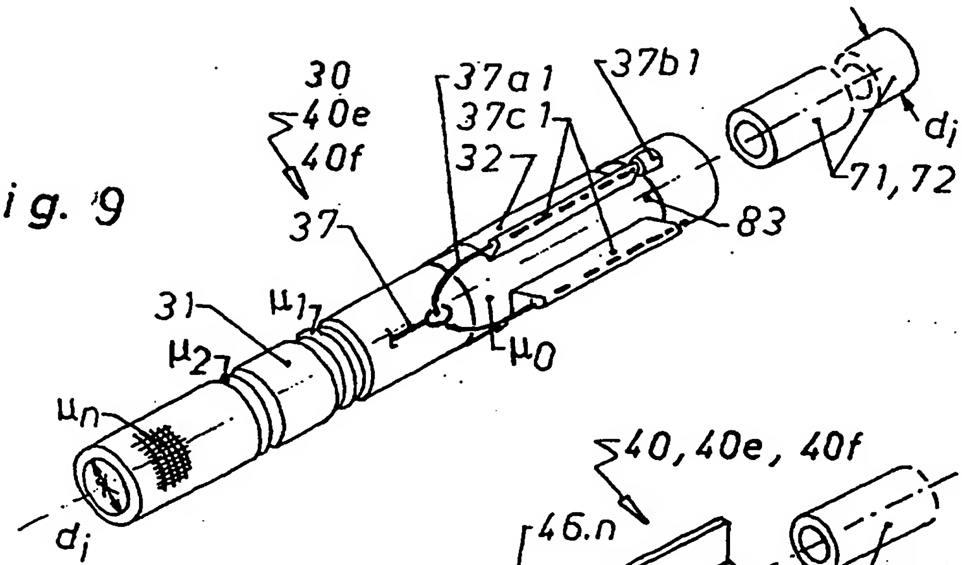
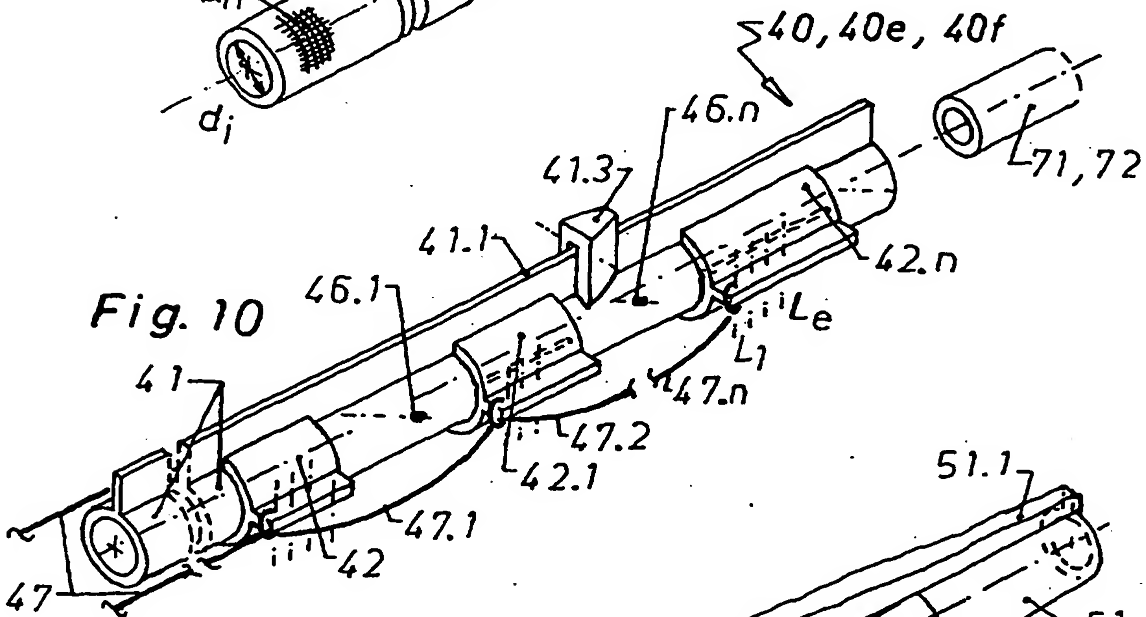


Fig. 10



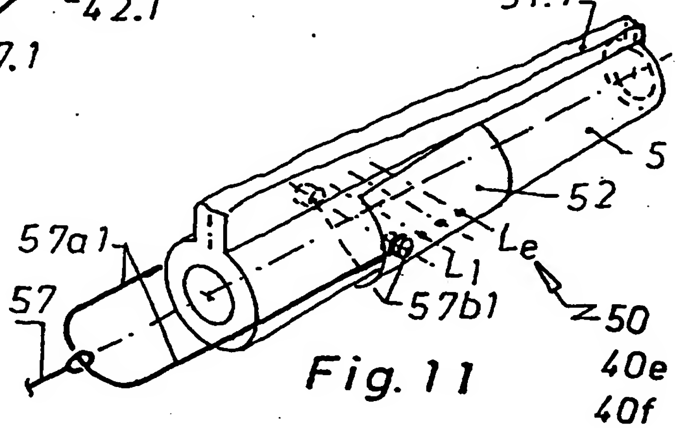


Fig. 11

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Fig. 12